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ABSTRACT

Knowledge of the processes involved in visual and auditory perception, as well as basic understanding of the mechanisms employed by the human brain in transforming perceptions into cognitions are prerequisites for the study of television aesthetics. Numerous scientific studies now found in such diversified fields as perceptual psychology, neurophysiology, experimental psychology, cybernetics, and communication confirm how fundamentally important perception is to the study of the structure of television images. This, in turn, is of great significance for the study of the field of television aeshetics. The paper: (1) reviews the most appropriate sources in the literature of visual and auditory perception as they relate to television aesthetics; (2) examines the predominant visual, auditory, and kinetic (motion) factors involved in structuring television images; and (3) discusses the role of perception in the development of television pictures with aesthetic merit. The paper concludes that an attempt to bridge the gap between scientific research on perception-related variables and artistic experiments in the visual communication media is long overdue and that extra efforts should be made toward that goal. (Seventy-seven references are attached.) (Author/SG)

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Perceptual Factors in the Study of Television Aesthetics

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Abstract

Knowledge of the processes involved in visual and auditory perception, as well as basic understanding of the mechanisms employed by the human brain in transforming perceptions into cognitions are prerequisites for the study of television aesthetics. Numerous scientific studies now found in such diversified fields as perceptual psychology, neurophysiology, experimental psychology, cybernetics, and communication confirm how fundamentally important perception is to the study of the structure of television images. This, in turn, is of great significance for the study of the field of television aesthetics. This paper (a) reviews the most appropriate sources in the literature of visual and auditory perception as they relate to television aesthetics, (b) examines the predominant visual, auditory, and kinetic (motion) factors involved in structuring television images, and (c) discusses the role of perception in the development of television pictures with an aesthetic merit.

INTRODUCTION AND REVIEW OF LITERATURE

The field of television aesthetics like the similar fields of aesthetics in painting, photography, and, generally, the arts, evolved from the field of criticism. The description, interpretation, and evaluation of television programs by various television commentators, observers, and critics generated the need to examine the critical statements more thoroughly and to relate them to the medium of television. It is for this reason that criticism of the arts has also been named meta-criticism, and television meta-criticism is synonymous with the term <u>television aesthetics</u> (Dickie, 1971).

The efforts of pioneer television critics during the last fifty years, first to identify and then to describe, interpret, and evaluate the various features of television programs might have resulted in the development of the field of television criticism. However, since the majority of these critics were from such conventional disciplines as sociology, anthropology, journalism, semiotics, linguistics, English, etc., the discipline of television criticism as a responsible academic discourse could not be fully developed and flourish. It was inevitable that with such limited and biased basic television criticism, television meta-criticism or television aesthetics could not progress and fully develop.

Visual communicators and media scholars who have observed and pointed out this phenomenon have suggested that the domain of the field of television criticism, and subsequently, the field of television aesthetics must be expanded beyond the sociological, semiotic, or linguistic approaches which has been the practice during the last fifty years. The medium is not an isolated sociological or unique linguistic phenomenon to be studied only by these respected fields. It is a complex phenomenon which is better understood if it is examined from all aspects and by many different disciplines whether they fall under the arts or under the sciences. The visual communication media scholars of today have observed, studied, and concluded that the development of television

criticism, which is the basis for the establishment of the discipline of television aesthetics, must expand and must take into consideration the findings in the fields of perceptual psychology, neurophysiology, experimental psychology, cybernetics, education, fine arts, communication studies, etc.

The studies on television criticism and television aesthetics of a great number of pioneer scholars, as well as our own studies, have indicated that the three-axes, the three bases upon which the discipline of television aesthetics should be built are perception, cognition, and composition (Metallinos, 1991). In this paper we focus only on the perceptual factors in the study of television aesthetics and we examine the roles played by vision, hearing, and motion in the perception of television images.

Specifically, in this section of the paper a brief review of the literary sources pertaining to the above perceptual factors in the study of television aesthetics is provided. The second part examines the predominant visual factors involved in the perception of television images. The third section analyses the key auditory factors, whereas the fourth part of this paper discusses the major kinetic or motion factors in the perception of television images.

Television aesthetics is the study of sensory data and images. Consequently, the major fields which contain the bulk of literary sources on the discipline are perceptual psychology, neurophysiology, art criticism, and communication. Since the discipline is still in the making and it has not, as yet, fully developed its parameters, the scholars of television aesthetics are constantly borrowing from numerous other academic disciplines to support their research findings. As difficult as this task may be, it has proven that it is both necessary and fruitful.

Among the present day communication scholars who have borrowed and have adopted in their own research from the perceptual psychologists and the neurophysiologists are J. Fletcher, R. Tiemens, M. Malik, and H. Zettl.

James E. Fletcher (1985), a communication scholar of the University of Georgia, has used the psychophysiological instruments, mostly the Galvanic Skin Response (GSR), as measuring devices in his television production related research (Fletcher, 1971, 1976, 1978, 1979, 1985).

In addition to this particular background in communication research, Fletcher has borrowed heavily from Berlyne (1960), Edelberg (1970), Lykken and Venables (1971), Shapiro and Crider (1969), and Venables and Martin (1967) all renowned researchers in neurophysiology and experimental psychology. Fletcher's empirical studies found in the journals and the literature of both fields have contributed decisively in the development of television aesthetics as a distinctive academic study and discipline.

Robert K. Tiemens (1976), a communication scholar at the University of New Mexico, has studied and published extensively such television production related issues as: Some relationships of camera angle to communication credibility (Tiemens, 1970), The syntax of visual messages: An empirical investigation of the asymmetry of the frame theory (Avery & Tiemens, 1975), Image size as an element of visual language (Tiemens & Acker, 1976), A visual analysis of the 1976 presidential debates (Tiemens, 1978), Children's perception of size in televised images (Tiemens & Acker, 1981), etc.

In his research Tiemens (1976), borrowed heavily from such known perceptual psychologists as Arnheim (1974), Gazzanika (1967), Gibson (1950, 1979), Goldstein (1975), Ornstein (1972), etc. Tiemens' research works, articles, and papers which can be found in all the major communication journals, have significantly helped the development of television aesthetics as a unique academic discourse.

Miroslav F. Malik (1987) a communication scholar from Czechoslovakia is among the first media researchers who established a Biocybernetic Research Laboratory, at Concordia University

in Montreal, to study moving images--mostly film and television pictures. In his research Malik used such advanced visual image measuring devices as Eye-trucking cameras, Galvanic Skin Responses (GSR), Electroencephalograms (EEG), and Electrocardiograms (EKG).

Malik's major work is contained in the monograph Biocybernetic Communication Research co-authored with Thwaites (1987). Among his other major publications and papers are: Information design (Malik, 1976), Videophysiology (1978), Biometric approach to communication process (Malik & Thwaites, 1984). Malik has studied neurophysiology at the University of Prague and has extensively quoted in his media-related research such notable neurophysiologists and perceptual psychologists as: Axelrod (1976), Briggs and Swanson (1970), Hubert and Wiesel (1979), Snyder (1982), Young and Sheena (1975), etc. Malik's contribution in the area of research methodologies for the visual communication media, in general, and the television medium, in particular, are substantial. His Biocybernetic Laboratory has encouraged several communication scholars, teachers and students, to pursue scientific studies in visual communication media.

Herbert Zettl (1990), a broadcast communication arts scholar at San Francisco State University, is considered the founder of television aesthetics as a distinct field of study. Zettl is among the most diversified media scholars, having mastered the fields of music, painting, television production, media education, and visual arts. Zettl's main works, the two books Television production handbook (1984), and Sight, sound, motion: Applied media aesthetics (1990) have been, for the last twenty-five years, the major text books in television production and television aesthetics respectively, and they have been translated into various languages around the world. Among Zettl's other noticeable publications and paper presentations on television aesthetics are: The paradox of education television and the educational process (1967), The study of media aesthetics (1978), Languages of television: The language of television criticism (1978),

The rare case of television aesthetics (1978), Video in depth: Multiple monitors show subtext (1985), The graphication and personification of television news (1989), etc. Among the numerous perceptual psychologists, neurophysiologists, Gestalt psychologists, and art psychologists quoted most frequently by Zettl are Arnheim (1953, 1969, 1969), Dondis (1973), Goldberg (1951), Goldstein (1975), Kepes (1944), Koffka (1935), Tarroni (1979), etc. Zettl's basic approach to the study of television is the inductive analysis of the basic picture elements of lights, colors, two and three-dimensional space, time-motion-editing, and sound. He is a contextualist who believes that since life and art are inseparable, so should the television picture and the entire television program be live and artistic, elevating viewers involvement and appreciation.

From the research works of these scholars and their numerous disciples we have extracted and gathered together the major perceptual factors--visual, auditory, and motion--which, in our view, constitute the parameters of the first axis of the study of television aesthetics. Herein, a synoptic description of the visual, auditory, and motion factors is provided.

Visual Perception: Defining the Visual Field of the Television Screen

Any attempt to define the visual field of the television screen will be fruitless unless we clearly understand and thoroughly examine both the organs and the processes involved in visual perception. In this section, such basic visual communication related processes as (a) visual stimuli, (b) the peripheral vision, (d) the perception of elements within the visual field, and (e) the perceptions of holographic and three dimensional visual displays are briefly examined in relation to television images.

Visual Stimuli

Visual perception is a highly important sensing system. More information reaches the human brain through the eyes than through any other sense organ. Most organisms have two eyes, either

both in front or one on each side. For most mammals the gradual change from sideways to frontal looking eyes occurred as precise judgment of distance became important. The use of two eyes cooperating to give stereovision is an important process in visual perception. Sight developed as living organisms needed to react to the electromagnetic energy we call light. Light is essential to life. It is necessary for most organisms to live and to grow in. It is the key ingredient to visual perception and to orient us in space and time. The receptors of the eyes are sensitive to only that tiny portion of the vast spectrum of electromagnetic radiation which we call light. The visible spectrum measures 400 to 700 nanometers wavelength.

Light strikes the eye, it travels through the complex structure of the eyeball to the retina where it is translated into electrical energy and then it is transmitted to the brain where it is organized, decoded, and perceived.

In order to understand this entire process we need to know first the physiology of the eye. This entails a clear understanding of the various parts of the eyes and their functions. Since the television camera was developed from the anatomy of the human eye to which it has a great resemblance, knowledge of the physiology of the eyes and the nature, the role, and the specific functions of the lens, iris, pupil, cornea, retina, fobea, the rods and cones, the optic nerve, etc. are necessary. Second, we need to fully comprehend the mechanism of visual perception step by step; that is we need to understand what is going on in the eye from the moment the light strikes the cornea, transfers into the light sensitive receptors at the back of the eyeball--the rods and the cones--and then, through the optic nerve to the brain. Third, we must learn to distinguish the potential stimuli exposed in the visual world from those of the effective stimuli (picked up by the eye) and the unaffected stimuli (ignored or overlooked by the eye).

The Perceptual Process of Television Images

The potential stimuli of the visual world, objects, events, sounds, etc. around us can all be thought of as distal stimuli. They are at a distance and they elicit electromagnetic waves. As long as such waves reach the receptors of our senses and they interact, they become proximal stimuli. They arrive in the organs of perception and are ready to be processed. Our sense receptors process the proximal stimuli as chemical reactions and transmit them to the brain. When the brain receives a stimulus as a chain reaction it perceives it. The responses of the brain are the perceived stimuli now known as cognitions.

Visual perception, as with any other sense, depends upon incoming stimuli to activate the receptor cells, otherwise we would not sense. Let us see what happens when we look at a television program.

The television set itself, and the light coming from the picture on the television screen are the distal stimuli. They are there, in the environment. The light that emanates from the screen enters the cornea and the lens of our eyes, travels through the fluid chamber of the eyeball, and strikes the retina. The light impinges on the receptor cells, the rods, and cones and can now be called proximal stimuli. This stimuli will then be processed within the light receptors and then to the brain for interpretation and understanding. In the brain, the proximal stimuli become the perceived stimuli.

Central and Peripheral Vision and Television Images

The discussion of the central and peripheral vision as they relate to television images entails an examination of what the domains of the central and the peripheral vision are, what the differences between the visual world and the visual field are, and what the differences between the big (film) and small (television) screens are.

Our eyes do not operate independently of each other. Neither eye can be moved without the other being effected in some way. There is an area in our field of vision where both eyes see the same objects and events but at a slightly different angle. The overlap measures approximately 120 degrees given as binocular vision. Binocular vision allows us to see--perceive--depth. Without it, we would live in the flat world of height and width.

The center of the overlapping field is known as central vision. This type of vision is very precise and accurate. At the perimeter of our visual field is our peripheral vision. Although it usually remains out of focus, peripheral vision is particularly sensitive to movement and contours.

Our total span of vision is 180 degrees horizontally and 150 degrees vertically. This restriction in our visual field has resulted in the rectangular shape, usually 3:4 aspect ration of the television screen.

As we take a look around us we see objects and experience events as they relate to us. This is our visual world. The streets, the people, everything around us is real and tangible. But when we see and experience the same objects and events reproduced on the screen they appear changed, usually smaller, and often less. The phenomena in the real world are different than the same phenomena when they appear in the visual field.

The television camera captures only a small fragment of the visual world. The camera's visual field is transmitted to thousands of television screens around the world. Often we see only a bird's eye view of the world and world events. The images on television are reproductions of the real world which have been edited, manipulated, and squeezed onto the television visual field.

The perception of the television screen is quite unlike that of the film screen. The relative small size of the traditional television screen means that we usually exercise only our central

vision while watching television. The eyes have very little space over which to move. Consequently, most of the information value of objects on the screen is obtained immediately.

In the movie houses because the screen is so much larger we experience both central and peripheral visions. Since we do not see all of the screen at once, our eyes and head move constantly. In this way our brain is kept more active in its effort to piece all fragments of the screen together. We remain more alert. The size difference of the two screens--film and television--causes the image size of objects and events to look bigger or smaller, more powerful or weaker. The film images are visually louder than the images of the small television set. A large image exerts more aesthetic energy than a smaller image, or the same image on a smaller screen. At the theatre we perceive people and things as being of dramatic proportion, not only physically, but also psychologically. The landscape carries as much energy as the people; both are overwhelmingly strong and in competition for screen space. On the large movie screen the simple act of a man walking down a country rode becomes a gesture. On the small screen this remains a simple act (Zettl, 1990).

The Perception of Elements Within the Visual Field

The analysis of the central and peripheral vision--which brought into focus the properties of the small (television) and the large (film) screens--leads to the examination of the perception of the visual elements of light, color, image size, image pattern, shape, and direction which appear on the small television screen. The analysis of motion of the visual elements is discussed separately in the fourth part of this paper.

The television picture is an interplay of lights and colors. It is, therefore, important to understand the properties of light and color if we are to comprehend how this visual medium operates.

Light is electromagnetic energy. It makes up a small part of the electromagnetic spectrum which includes radio waves, infrared, ultra-violet, X-rays, and gamma rays. What we see as light is the visible part of spectrum. It consists of wavelengths measuring between 400-570 nanometers. Color is a property of light. When light is bent by a prism each wavelength is deviated through a slightly different angle so that the emerging beam comes out of the prism as a fan of light, giving all the spectral colors.

When we look at objects or liquids we see light as it is reflected off them and when we see color we actually perceive three basic color sensations--the color itself which is called hue, the color's strength which is called saturation, and how light or dark a color appears which is called brightness. These three sensations are called color attributes. Unlike the old black and white television picture, today's color television pictures have all these attributes.

Color vision scientists (e.g., Guyton, 1986) have found that there are three different types of cones in the retina of the eyes each of which responds maximally to three different colors: blue, green, and red. The colors we see depend on which of the three cone types are activated and to what degree they are stimulated. Each type cone is excited most effectively by light of one particular wavelength but it also responds to other wavelengths. According to Yauder (1985), "Our sensation of color depends upon the ratios of these three cone outputs and their comparison by higher order cells in the visual system" (pp. 655-656).

Light and color perceptions are also very important because they directly influence the perception of image size, pattern, shape, duration, etc. The difference of light and color of their borders determines the degree of our perception of them. The position, size, direction, and motion of objects and subjects in space are all directly related and can be perceived due to light and color.

The Perception of Holographic and Three-Dimensional Elements

This section briefly examines (a) the perception of holographic images, (b) the perception of three-dimensional images, and (c) the perception of the figure-ground hierarchy in television images.

In the real world we are used to seeing and relating to our surroundings in three dimensions. Until recently our artistic expressions in the mass media had been confined to two-dimensional means. Photography, film, and television are all flat media. They have no actual depth. The sense of the third dimension is an illusion created by manipulating subjective space. Recent developments in the fields of holography, film, and three-dimensional television imaging have made three-dimensional images look almost realistic. Objects in holograms and in three-dimensional film and television images appear to extend beyond the screen towards the viewer.

As the words holo (complete) and gram (message) connote, the hologram captures the entire message of the scene in all its visual properties, including the realism of the third dimension.

The magic of a hologram can be demystified if we understand light and how images are captured on film. In regular photography, light waves bounce off a subject and pass through a lens. The lens focuses the light waves onto an image and we see a flat two dimensional photo of the actual object. In holography, however, the lenses precisely guide the light which must be coherent or monochromatic and is known as laser--acronym from light amplification by the simulated emission of radiation--reflecting off all points of the subject. These light rays are recorded in three dimensions. Praising the perceptual property of holograms Kock (1969) states,

> The hologram plate itself resembles a window with the image scene appearing behind it in full depth. The viewer has available to him many views of the scene to see around the object in t he foreground, he simply raises his head or moves it left or right. (p. xi)

The many uses of holography today, which include air traffic control, radiative surgery and therapy, topography, computer-aided design, supermarket counter checking, advertising, and

education is an additional reason for the student and the researcher of the visual communication media to examine the perceptual properties of holography vis-a-vis their potential covert effects (Metallinos, 1990).

An equally important perception factor is the three-dimensional television which is emerging rapidly thanks to the vigorous research of the Media Lab scholars at M.I.T. and the Japanese Industrial (Sony) and Education (NHK) technologists.

Three-dimensional television has not, as yet, been perfected. It is in the experimental stages where either the television cameras, the television sets, or the television viewers must use special converters, apparati which are substitutes to man's perceptual property of binocular vision. The volumetric three-dimensional imaging method (Balasubramonian & Rajapan, 1983) and the three-dimensional holographic television (Brand, 1987) are among the recent three-dimensional television in existence. Their massive application, however, might have negative results. Studies on this issue have shown that there are numerous perceptual and aesthetic drawbacks of the three-dimensional media which should be considered (Metallinos, 1990).

It is very important for television and for that matter for any visual art form to maintain a figure-ground relationship otherwise viewers will not be able to distinguish objects from their background and they will not perceive depth properly. As Murch (1973) states, "The exchange [of figure-ground relationship] is marked by a modification of the apparent depth of the figure; the figure portion always appears to be infront of the ground" (p. 147).

We are compelled to structure what we see in the figure-ground relationship. Objects are constantly seen relative to a background. Because of this urge, we can achieve especially startling effects by rendering the figure-ground purposely ambiguous or by reversing them. Something like this is common practice in gimmicky advertising. In television, this effect can be produced by superimposition, quite effectively, particularly in dream sequences, etc.

Television would be a blur of moving images with little comprehension and minimum retention if the figure-ground relationship was in constant flip-flop. Maintaining a consistency in this hierarchy is imperative if we expect the viewers to properly perceive and make sense of television images (Metallinos, 1989).

Auditory Perception: Defining the Audio Dimensions of Television Images

An equally important, to the sight or vision, component of the television medium is sound which is often overlooked, taken for granted as being there. Empirical research on television sound which examines the role of audio in television aesthetics is practically non-existent (Metallinos, 1985).

We live in a society where most means of communication are through the process of sounds. The things we do or see often use sounds to be perceived and comprehended. For example, a television picture will be meaningless with the absence of sound. Sound emphasizes mood and provides meaning in a predominant visual medium such as television.

The effectiveness of sound depends upon the messages which are transmitted through the sound waves which can be manipulated with the audio technologies that exist within the medium of television.

In this section such basic audio communication related factors as (a) auditory stimuli process and mechanism of auditory perception, (b) perception of acoustic space, and (c) sound vs. noise in television are introduced and briefly discussed.

Auditory Stimuli: Process and Mechanism of Auditory Perception

The ear captures sound waves from the surroundings. It turns them into bits of information and processes them to the brain for understanding. Before this entire mechanism of auditory perception is explained we need to know the fundamentals about the physiology of the ear and the various functions of the auditory stimuli.

The ear is made up of many different and complex organs. It is divided into three sections: the external ear, the middle ear, and the inner ear. The external ear helps us to capture and identify the directions of the sound source. The external ear consists of the ear flap or pinna and the ear canal or external auditory meatus which leads to the eardrum or tympanic membrane. The ear canal varies both in shape and in size. The outer portion of the canal, about one-third of its length, is cartilaginous; the remaining two-thirds is bony. The canal takes on a somewhat s-shaped form and has a diameter of about 0.7 centimeters at its entrance. It gets smaller closer to the eardrum.

The middle ear begins with the inside part of the eardrum. In the middle ear cavity there are the three auditory ossicles. These three ossicles--the malleus, the inclus, and the stapes--transform sound vibrations into the inner ear. Also found in the middle ear is the eustachian tube. This tube is responsible for maintaining proper pressure equilibrium in the ear. The eustachian tube connects the middle ear to the pharynx. The slit-like ending of the tube in the pharynx is normally closed but during yawning, swallowing, or sneezing when the muscle movements of the pharynx open the entire passage, the pressure in the middle ear equilibrates with atmospheric pressure. A difference in pressure can also be produced with sudden changes in altitude such as in an elevator or airplane.

The inner ear is the area where sound vibrations are converted into electrical impulses and propagate through the auditory nerve to the brain for interpretation and understanding. The inner ear structures are contained within a system of spaces and canals--namely the osseous labyrinth. These spaces and canals are grossly divided into three sections: the vestibule, the cochlea, and the semi-circular canals.

The total range of hearing in a healthy young adult is between 16 and 20.000 Hz. The sounds heard most keenly by human ears are those from sources vibrating at frequencies between 1000 and 4000 Hz.

The first step in hearing is the entrance of pressure waves into the ear canal. These pressures, or sound waves, are transmitted to the eardrum. This thin membrane bows inward under the pressure of the sound waves. The extent to which this membrane moves depends upon the force with which the air molecules hit it, and it is related to the loudness of the sound.

The second step of hearing is the transmission of sound energy from the tympanic membrane, through the middle ear cavity, and then to the fluid-filled chambers of the inner ear. The total force of the tympanic membrane is transferred to the three ossicles in the middle ear. At the end of this bony chain the sound energy is transmitted to the oral window, a thin membrane that connects the ossicles of the middle ear to the inner ear.

The mechanical vibrations are translated into electrical signals within the organ of corti in the inner ear. This organ is a collection of about 23,500 sensitive receptor cells which transduce sound energy into action. The organ of corti is located along the top of the basilar membrane. The basilar membrane stands as a thin and stiff organ near the oral window at the beginning of the inner ear. It progressively becomes larger and flabbier as it descends down to the wall of the cochlea. Lying like a flap over the organ of corti is the rectorial membrane. These two membranes are divided from the rest of the cochlea by the Reissner's membrane and are bathed in a fluid called endolymph.

The cells in the organ of corti are lined with small hairs. These hairs stick out through the rectorial membrane. As sound vibrations enter the inner ear they cause these hairs connecting the two membranes to bend and it is in the bending of the hairs that the conversion from mechanical

sound vibrations to electrical impulses occurs. The bending of the hairs triggers an electrochemical reaction in the cells and the generation of electricity. According to Chedd (1970),

> What happens to the sound remains a mystery. All we know is that it is encoded in spikes of electrical activity as each hair cell fires, but the nature of the code is unknown. The unravelling of this code is complicated by the fact that the hair cells continue to fire even in the absence of sound. (p. 29)

Since the fifteenth century scientists have debated on what constitutes a sound. If a tree falls in the forest and no one is there to hear it, will there be sound? The answer of course, depends upon whether sound is to be considered a physical vibration transmitted through the ear, or just a sensation inside the mind of the listener. The first statement is the cause and the second is the effect. As a sound receptor the ear gathers sounds, manipulates them, and processes them to the brain to be decoded just like the eye gathers, manipulates, and processes sights.

Sound has power. It actually represents a flow of power from one place to another, a flow that can be modified by the medium through which it travels. If the sound elicits a response from the organ of hearing then that sound is an effective stimulus. If the sound goes undetected by the ear then the stimulus is ineffective. Effective sound stimuli travel through the ear and to the brain where we become aware--we perceive--the sound as having occurred.

Sound adds new dimensions to the sense of sight. It has the power to alter such emotions as joy, terror, love, hate, etc. Most importantly sound forms the basis of speech, our most powerful means of communication. However, the emotional or psychological effects of sound vary depending on each individual's taste, mood, and conditions under which the sound is being heard. Although sounds can produce certain common behavioral effects tests have shown that each individual provides his/her own interpretation of sounds. This factor is grossly overlooked by commonly used television measuring devices.

The Perception of Acoustic Space

The perception of acoustic space, which examines the issues of sound localization cues, distance, and direction judgments, is of great significance to the study of television aesthetics because the television image constructors must work effectively with television audio equipment, microphones, turntables, audio consoles, etc. Mastering television audio techniques is a slow process which first requires thorough understanding of the perceptual process of acoustic space.

It has been established that because we normally hear with two ears, we can locate sounds in space in a manner "analogous to the visual depth perception and angular acuity that we process within the two eyes" (White, 1975, p. 125). Our two ears permit us to determine the horizontal angle between the line pointing to the two ears and the direction of the incident sound. The perception of the direction of the vertical angle is poor (White, 1975).

Experiments in sound localization have attempted to discover the specific physical sound cues available to the listener and their nature (Gulick, 1989). To be able to localize sound sources is considered to be the most important ability in a person because it helps to recognize the direction of the objects to look for and/or to avoid.

According to Moore (1989), "The term 'localization' refers to judgments of the direction and distance of a sound source. Sometimes, when headphones are worn, the sound image is located inside the head" (p. 194). In some cases not only are we able to figure out the direction of the sound source but we are able, somehow, to estimate the distance. This ability is most prominent in blind people. Their survival depends on fine acoustical interpretation as they cannot see where they are going. Their ears do the seeing for them. Blind people can use information from echoes and sound reflections to determine the position of the objects in the environment.

Among the sound cues that enable us to localize sounds in our environment are the proximity of the sound to our ear, the inequality of the intensity from one ear to the other, and the minute

difference in the time arrival of the sound. For example, for low-frequency tones the difference in phase is the cue for localization, whereas for higher frequencies it is the loudness that allows us to localize the sound. Sound sources located in one side of the head reach the nearest ear before they reach the other. This delay is measured in a fraction of a second but the ear is so sensitive that it records the discrepancy and interprets it as sound coming from a specific direction.

Sound localization is harder for sounds that are situated directly infront or behind our heads. There are no cues because both ears receive the same information at the same time. It is in these instances that the skills and active imaginations of the television sound engineer are required the most because in television it is important, aesthetically, to match the sound levels to the direction and distance of the action.

An important aesthetic principle to be considered when we try to match the sound levels to the direction and distance of the action is the figure-ground relationship and its perspective. The figure-ground relationship in the case of sound concerns itself with the determination of important sounds as figures, or foreground, and matching these sounds to the background. For example, there is, on a set, a couple sitting in a cafe whispering thoughts to each other. On a long shot the visual aspects of the waiters and other people talking near the couple are equally prominent, therefore,the couple's voices can be mixed with the others. On the other hand, in a close-up of the couple a clearer visual figure-ground relationship is established. The couple will stand-out from the other people, therefore the sounds must be accordingly matched.

The perspective of sound parallels that of the signals. It concerns itself with mastering the close-up shots with close (foreground) sounds and the long-shots with farther away (background) sounds. This practice is not always considered in television programs and the entire aesthetic quality of such programs suffers considerably.

Sound and Noise in Television Images

It has been established that sound is the motion or vibration of an object. This vibration creates disturbances in the surrounding medium (i.e., the air) causing atmospheric particles, or molecules, to be either squeezed closer together than normal, an action known as condensation or to be pulled farther apart from each other, an action known as rarefaction.

Noise and sound are both audible vibrations of the air. The distinguishing factors between the two are in the control, the purpose, and the organization. Sounds have purpose and they are organized. Noises are at random and unwanted. Sounds can be controlled. They can be switched on or off at will and regularly, on the other hand noise is uncontrollable sound.

Noise pollution has become an environmental problem in contemporary society which has created noise through its technology and has tolerated it with only little attempt to control it. Some observers believe that "noise as an environmental pollutant has recently become an object of serious social concern" (White, 1975, p. 179). Over a long period of time very intense noise in our society will cause gradual nervous or mental illness and loss of hearing. These damages occur mostly to people working in industrial jobs such as construction, metal working, and those near busy airports. The visual communication media are also sources of noise when their sounds are abused.

According to Zettl (1990), "Television is definitely not a predominantly visual medium; it is an audio-visual medium. Silent television is inconceivable from an information, as well as aesthetic, point of view" (p. 335).

Consequently, the successful perception of a television picture depends on the proper structure and control of the picture/sound combination. Auditory and visual perceptions must be organized in the same manner, they must be properly and simultaneously combined so that they may form a synergistic structure. This is not always easy to achieve and each case has its own

requirements. Research has shown that the matching criteria for pictures and sounds, that is, the ability to simply perceive pictures and sounds together as a unit, can be grouped under such umbrella categories as historical, geographical, tonal, overtonal, and structural (Zettl, 1990).

The various efforts to improve the sound quality of commercial television programs by introducing stereo television sound have had negative, aesthetically speaking, results. The high quality sound does not improve, but rather diminishes, the low definition of the conventional television pictures. When watching a rock concert on television and listening to it through the FM radio channel the results are disappointing since the high quality sound diminishes the low definition picture of commercial television. However, the advent of High Definition Television will match perfectly the high quality of stereo television sound when the new medium will be universally introduced (Metallinos, 1990).

Since it is the sound track that lends authenticity to the picture and not the other way, around television image constructors must be cognizant on the various factors of auditory perception mentioned above.

Vision in Motion: The Perception of Moving Images

The visual communication media of film and television are called kinetic (Greek, meaning movement) media because they present signals and sounds in motion. Film and television pictures are moving images. The study of the perception of movements of the television images, both visually and acoustically, provide significant knowledge in the study of television aesthetics. In fact, the study of motion in televised images touches all three axes, perception, cognition, and composition of television aesthetics.

Although the present brief introduction of vision in motion deals mainly with the perception of motion, visually, it should be pointed out that there is a substantial body of research dealing with the auditory domain of motion as well. Studies which integrate these two domains provide a

valuable holistic approach to understanding the perception of motion. For the purpose of clarity and direct application of issues pertaining to the television medium this introduction is limited to the visual domain of the perception of motion. Specifically, in this section such major topics as (a) general theories on the perception of motion and the movement of the observer, (b) real movement and apparent movement, and (c) the generation and the perception of movement in the visual field, will be discussed.

General Theories on the Perception of Motion and Movement of the Observer

The perception of motion has traditionally been treated as a troublesome subject among perception researchers. Initially, the camera formed a basic analogy to the perception characteristics of our organic eye. To the researchers, the optic stimulation of the retina was essentially similar to a static two-dimensional projection of the interior back wall of the camera. Some general observations from this phenomenon formed the bases for the initial theories of visual perception. With the advent of motion perception and the many questions surrounding it, the answers were formulated on the acceptance of the sequential series of static images. It was the limitation of this application which led to the inadequacy of explanations and even caused subsequent obstacles to motion perception comprehension and further delayed the inadvertent progress of research of this phenomenon.

It was the view of some researchers (Cutting, 1986) to categorize perception into external presentation which is the information about objects and events, and into internal representation which is based on the cognitive science research. It is interesting to note that the perception of motion has been of interest not only to contemporary researchers in the psychophysics domain but throughout the centuries to men of sciences as well as philosophy and the arts. Starting with this historical concept of perception and metaphysics we can see why we perceive things as we do.

Koffka (1935) and Gibson (1950) were the pioneers in this quest. They both understood the perception to be based on the process of picking up or absorbing information.

Such information, however, had to be derived from somewhere and it was Gibson (1979) who proposed, only recently, that such information comes from the environment during a given perceptual act. This information is processed according to the principle laws of optics and perspective geometry. Ullman (1980) also investigated the nature of three-dimensional solutions from two-dimensional projections of objects in motion in the belief that the eye and the camera are compatible. Recent researchers, however, do not share these views since the eye does not have a shutter or an exposure time and it cannot see or record a moving image the same way the camera does (Berkeley, 1986, Pong, Kenner, & Otis, 1990).

The most common area of investigation relating to the movement of the observer is called the motion--parallax. It refers to the relative displacement of objects due to the observer's change of placement first analyzed by Euclid in the fifth century B.C. and then by German physiologist and physicist Helmholtz (1821-94), who had observed the effects of the movement of the observer on the perception of distance. What happens to the observer when he/she is moving is that he/she will continuously fixate on a particular point of reference and his/her image will remain stationary on the retina during a brief period of time. At the same time, images of objects that are further and/or nearer will shift in opposite directions over the retina surface. Actually, the points that lie further away than the reference will appear to move in the same direction while the objects that are closer will seem to move in the opposite direction.

Real Movement and Apparent Movement

In order for motion to be visually perceived there must be a displacement of an image on the retina. Berkeley (1986) indicated that there can be three different manners which bring about this displacement, (a) the movement of a real object causing the displacement on the retina, (b)

when eyes follow a stationary object, and (c) the displacement of different objects or shapes from each other. Johansson (1975) describes such stimuli through the dimension of speed and the direction of movement. According to Johansson (1975) the speed is given in degrees of visual angle per second and the direction is usually given in polar coordinates.

Pong, Kenner, and Otis (1990), have studied the perception of real movement through the analysis of stereo and motion cues in pre-attentive vision processing by using random dot stereographic image sequences. Pong et al. (1990), explore the relationship between such cue optical flows as stereo disparity, accretion, and deletion of image points.

In similar fashion to real movements, where there is displacement of the image of the retina, a perception of movement can be obtained through sequential displacement of this retinal image even though no movement occurs. What this effect accentuates are the temporal characteristics of the visual systems. Most studies which deal with this topic focus on the determination of the threshold magnitude that will result in the perception of apparent movement. The criteria identifying the visual substrates of visual perception can be studied through direct methods which are most commonly used or through indirect methods which are mostly behavioral, comparing humans and primates.

Apparent motion is a frequent phenomenon which includes film and television and which constitutes the major discussion in cognition and composition. Initially though, the principle of apparent motion was studied by Korte (1983) and by Neuhaus (1983). Their results were inconclusive or simply not accurate although their research was headed in the right direction.

Recently Antsis (1990) published interesting experiments in which he demonstrates motion aftereffects from a motionless stimulus, yet another indication of apparent motion. He accomplishes this through the dimming or brightening of static light or dark bulbs.

Anstis (1990) has studied the correspondence problems relating shape information within moving images and motion information between pictures. The correspondence problem refers to a succession of images shown rapidly one after the other so that apparent motion is perceived if the two pictures are sufficiently similar. But how similar must they be? Ullman (1979) has labelled this task the correspondence problem. Anstis (1990) then investigated what happened when the criteria of similarity and proximity were placed in experimental conflict.

Scientists are still not clear as to how real and apparent movements are generated. The mechanisms for processing the perceptual information structuring from real movement is not easily distinguishable from that of apparent movement (Green & Grunnan, 1983). More recent findings by Badler and Tsotsos (1986) suggest that real and apparent movement are processed at some stage by two different perceptual mechanisms.

As with most other present day scientific endeavors perception of motion research has offered us two basic thrusts. Through great technological innovation and an immense amount of observations hypotheses and theories have been generated. For the most part, it has been enlightening--providing a clear understanding of the motion phenomena. Yet such studies do not relate and they are not at all complimentary to studies in other fields. For example, the film and television viewers perception and comprehension of moving images is rarely discussed in scientific journals, other than those found in the communication field.

The Generation and The Perception of Movement in the Visual Field

Gibson (1979) is the most prominent among the scientists who managed to narrow the gap separating the moving image makers and the visual communication media scholars, from the perceptual psychologists and neurophysiologists. Gibson (1979) recognized both the need for special attention to the studies of the visual communication media of film and television and the

need to combine such efforts involving experimental psychologists and movie makers. According to Gibson (1979),

> The progressive picture [film and television] displays transformations and magnifications and nullifications and substitutions of structure along with deletions and accretions and slippage of texture. These are the "motions" of the motion picture, as I put it in Chapter G. They are thoroughly structured with meaning. They are lawful, even if not described by geometry. They can show people, animals, objects, places, and events with the utmost precision and elaboration. They need to be studied by experimental psychologists on the one hand, and by experimental movie makers on the other. They cannot be usefully studied by taking the parameters of "motion" and plodding through the systematic variation of the traditional experiment. But on the other hand neither can they be understood by playing around with aesthetic intuitions. (pp. 293-294)

This paper is in support of Gibson's (1979) plea for cooperation and mutual understanding of the scientific and artistic domains for the development of the field of television aesthetics.

Other supporters of this notion prior to Gibson (1970) were Arnheim (1969), Kepes (1944), Moholy-Nagy (1947), and later on Zettl (1990), Tiemens (1976), and others. Their works have brought closer together the two domains--science and art--and they have established the foundation to the study of television aesthetics as a unique academic discipline. Zettl's (1990) major works, in fact, constitute a direct response to Gibson's (1979) suggestions and constitute the bases for television aesthetic research.

The perception of motion in television pictures is closely related to the concepts of change, space, and time. In the small visual field of the television pictures we observe changes from one field to the next, sometimes very rapidly, often twice as slow; we also observe changes of the environment, the space, the ground of the picture. We experience or we sense the passing of time

as it relates to relocation of space or to the speed of motion of the visual elements. We can slow down the motion of the visual elements (objects, subjects, events, etc.) within the frame, we can freeze the motion, or we can fast forward or accelerate the motion. Each of these motions of the moving images of the television pictures have their own aesthetic value which is determined by the moving image maker's own judgment.

To objectify such spontaneous decisions by the television directors and for the purpose of developing the guidelines--the rules of composition of moving images--the various motions that occur in the television screen need to be examined. Zettl (1990), has identified three such types of motions which occur simultaneously on the screen and he describes them as follows,

> Primary motion is event motion. It always occurs in front of the camera, such as the movements of performers, cars, or somebody running. Secondary motion is common motion, such as the pan, tilt, pedestal, zoom, dolly, truck or arc. Secondary motion includes the zoom, although only the lens elements, rather than the camera itself, move during the zoom. Still, aesthetically, we perceive the zoom as camera-induced motion. Tertiary motion is sequence motion. It is the movement and rhythm induced by shot changes by using a cut, dissolve, fade, wipe, or any other fancy transition device to switch from shot to shot. All three motions are important factors in structuring the fourth dimensional field. (pp. 272-273)

In summary, an understanding of the perception of moving images discussed here in terms of (a) general theories of the perception of motion and the movement of the observer, (b) real and apparent movement, and (c) the generation and the perception of movement in the visual field are prerequisites for the scientific study and the development of television aesthetics.

Summary and Conclusions

In this paper an effort was made to (a) isolate, (b) briefly discuss, and (c) clarify the major perceptual factors in the study of television aesthetics, stating, at the outset, that television aesthetics constitutes the first axis in the study of television aesthetics--the other two being cognition and composition.

The first section of this paper provided an introduction to the study of television aesthetics and a review of the literary sources in both perceptual psychology and the arts which constitute the bases for the study of the field of television aesthetics.

The second section provided a discussion of visual perception related topics such as visual stimuli, the perceptual process of television images, central and peripheral vision and television images, the perception of elements within the visual field, and the perception of holographic and three dimensional elements.

In the third section of this paper such auditory perception related topics as auditory stimuli, processes and mechanisms of auditory perception, the perception of acoustic space, and sound and noise in television images were briefly examined and exemplified.

The vision in motion section of the paper provided a review of the general theories on the perception of motion and the movement of the observer, discussed real and apparent movement in the visual media, and examined the three types of perceived motion--primary, secondary, and tertiary--in the visual field, the television screen.

The entire discussion on the perceptual factors governing the field of television aesthetics generates the following concluding remarks:

1. The development of the field of television aesthetics greatly depends on the knowledge and research findings of various scientific studies, found mostly in the fields of neurophysiology, perceptual, experimental, and cognitive psychology.

2. For the study of television aesthetics the understanding of the processes involved in the perception of all three domains, visual (sights), auditory (sounds), and kinetic (motion) is paramount.

3. The need to bridge the gap between scientific research findings on perception related variables and artistic experiments in the visual communication media--primarily film and television--is long overdue and extra efforts should be made towards that goal.

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